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REMARKS

This amendment is responsive to the Office Action of September 9, 2005. Reconsideration and allowance of claims 1-14 are requested.

The Office Action

Claims 1-8 stand rejected under 35 U.S.C. § 102 as being anticipated by Ehman (EP 0 708 340).

Dependent claims 9-14 are newly added.

The Prior Art

Ehman (EP 0 708 340) is illustrative of the acknowledged prior art. An elastic excitation, such as a sinusoidal acoustic excitation, is combined with an imaging technique that is perturbed by such elastic excitation so as to image or map elastic characteristics of a subject. Ehman measures Young's modulus of elasticity, which Ehman denotes by the symbol Y rather than the more conventional symbol E , in accordance with the Equation:

$$Y=c^2\rho$$

where c is the propagation velocity and ρ is the density of the gyromagnetic medium. See Equation 14. Ehman goes on in Equations 15-17 to describe other linear relations. Ehman discloses measuring other elastic properties such as Poisson's ratio (relating to transverse elongation), and other modulae, and velocity of propagation.

The Present Application

The present application recognizes a limitation in existing MR-based elastography in that the benign lesions also sometimes exhibit stiffness. To solve this problem, the present application discloses a technique for measuring non-linear elastic characteristics. These non-linear elastic characteristics, the present inventors have found, can better differentiate malignant lesions from benign lesions.

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The present application measures Young's modulus Y as:

$$E = E_0 e^{\alpha \epsilon}$$

where ϵ denotes deformation and α denotes the non-linearity coefficient. This model predicts that the stiffness increases exponentially with increasing deformation.

More specifically to a preferred embodiment, the present application determines the amplitude of the excursion of the spins at higher harmonics of the fundamental frequency. This embodiment of the measure of non-linearity is made from the ratio of the higher order to the fundamental amplitudes.

Thus, the present application relates to determining non-linear distortions; whereas, Ehman neither suggests nor provides an enabling disclosure of how one might measure non-linear distortions.

**The Claims Distinguish Patentably
Over the References of Record**

Claim 1 calls for determining the non-linear distortions. Ehman neither suggests nor provides motivation for determining such non-linear distortions nor provides an enabling disclosure as to how one might determine the non-linear distortions. The measurement of these non-linear effects is advantageous over the Ehman technique in that it better differentiates malignant lesions from benign lesions. Accordingly, **claim 1 and claims 7 and 9 dependent therefrom** are not anticipated by and distinguishes patentably and unobviously over Ehman.

Claim 2 calls for determining a measure of the non-linear distortions from the variation in time of the excursions. Ehman fails to teach or fairly suggest measuring any non-linear distortions.

Moreover, claim 2 calls for reconstructing the determined measure of the non-linear distortions into an image representing the extent of the non-linear distortions. Ehman does not teach or fairly suggest determining non-linear distortions, much less generating an image representing the extent of the non-linear distortions. Accordingly, **claim 2** is not anticipated by and distinguishes patentably and unobviously over Ehman.

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Claim 3 calls for determining the amplitude of the excursion of the spins at higher harmonics of the fundamental frequency. Ehman fails to teach or fairly suggest determining the excursion of higher order harmonics.

Further, **claim 3** calls for forming an image which is dependent on the ratio of the higher order harmonic amplitudes and fundamental frequency amplitudes. Ehman fails to disclose any such ratioing. Accordingly, it is submitted that **claim 3 and claims 4-7 dependent therefrom** are not anticipated by Ehman.

Claim 8 calls for determining the amplitude of the deflections of the spins at higher order harmonics. Ehman fails to disclose or provide any motivation or enabling disclosure for determining the amplitude of the deflection of the spins at the higher harmonics.

Claim 8 further calls for forming an image dependent on the ratio of the higher order harmonic amplitude and the fundamental frequency amplitude. Again, Ehman does not disclose generating an image based on such a ratio nor suggest that an image based on such a ratio would have the advantage in better differentiation of malignant lesions from benign lesions. Accordingly, it is submitted that **claim 8** is not anticipated by Ehman.

Claim 10 calls for determining a non-linearity coefficient α of Young's modulus as expressed by the formula: $E = E_0 e^{\alpha \epsilon}$. Stiffness, thus increases exponentially with increasing deformation. By distinction, Ehman expresses Young's modulus as $Y = c^2 \rho$, where c is propagation velocity and ρ is density, i.e., a linear function. Because Ehman fails to teach or fairly suggest determining a coefficient of an exponential expression, it is submitted that **claim 10 and claim 11 dependent therefrom** distinguishes patentably over Ehman.

Claim 12 calls for estimating elastic non-linearity from measured variations in the time of the excursions to which a Fourier transform is applied to yield a fundamental frequency amplitude and at least one higher frequency amplitude. Ehman fails to suggest this or any other technique for determining at least one higher frequency amplitude. Accordingly, it is submitted that **claim 12** distinguishes patentably and unobviously over the reference of record.

Claim 13 calls for determining excursion amplitudes at a fundamental frequency and at least at one higher order frequency. Again, Ehman fails to disclose

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or provide motivation for determining amplitudes at a higher order frequency. Accordingly, it is submitted that **claim 13 and claim 14 dependent therefrom** distinguish patentably over Ehman and the other references of record.

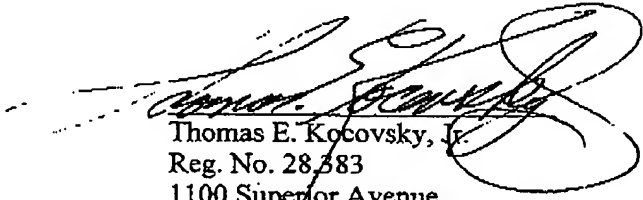
CONCLUSION

For the reasons set forth above, it is submitted that claims 1-14 are not anticipated by Ehman and that the claims distinguish patentably over Ehman. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, he is requested to telephone Thomas Kocovsky at (216) 861-5582.

Respectfully submitted,

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